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## AFRL tests heat pipe cooled leading edges

*by Holly Jordan, AFRL Air Vehicles Directorate*

WRIGHT-PATTERSON AIR FORCE BASE, Ohio — The Air Force Research Laboratory recently completed thermal validation to verify the performance of a heat pipe cooled wing leading edge, in an effort to further develop reliable, maneuverable space operating vehicle technology.

Heat pipes are metal tubes that move heat from one spot on a structure and redistribute the heat evenly over the structure's entire surface area. This redistribution prevents localized "hot spots" from forming; if left unchecked, these hot spots could potentially fail the component.

Scientists from AFRL's Air Vehicles Directorate are seeking to incorporate this heat pipe technology into a wing structure. Heat pipe cooled leading edges reduce the wing leading edge mass significantly compared to an actively-cooled leading edge. Since space operating vehicles require a high degree of maneuverability upon reentry, a small leading edge radius is critical.

In order to test the heat pipe cooled leading edge concept, researchers tested a heat pipe specimen, constructed of a superalloy (which can withstand very high temperatures) surrounding lithium (which melts at lower temperatures). When the wing becomes hot, as it would during reentry, the lithium within the pipes vaporizes at the hottest areas of the leading edge and condenses into a liquid at the cooler areas. This process evenly distributes heat throughout the leading edge and ensures that materials in the hottest areas do not exceed their temperature limits. During the testing, a 4-inch span of heat pipe 36 inches long was tested under heat lamps, which mimicked the heat distribution the structure would encounter in a reentry situation. The test verified functionality of the heat pipe and successfully determined the article's heat transfer capacity.

Leading edge heat pipe technology could potentially be used not only for a Space Operations Vehicle but also any type of reentry aircraft or hypersonic cruise vehicle. @

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